MI DEQ & RETAP Pollution Prevention (P2) Training

Metal Finishing: Electroplating P2

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Kentucky Pollution Prevention Center

Reduce Electroplating Costs

- Slow down
- Counter-current rinsing
- “Static” rinse
- Racking to reduce dragout
- Restrict water flow
- Drain boards
- Check bath chemistry
- Fogging/Spraying/Air
- Ion exchangers
- Electrolytic/Electrowinning

Pollutant Reduction & Water Conservation Methods

- Reducing pollutant loading in rinsing & washing operations
- Improving rinse efficiency
- Extending bath life
- Close-looping technologies
- P2 for boilers & cooling towers
- Other water conservation techniques

Water Use
Rinsing Process

- To understand the rinsing process:
  - Measure dragout volume
  - Measure rinse water volume
  - Measure rinsing effectiveness
- To modify the rinsing process:
  - Reduce the dragout
  - Improve rinsing efficiency
  - Reduce water use

Dragout = Waste = $$$

- "Dragout reduction is one of the most important low tech methods to reduce pollutant loading to waste water!"
- Keep plating solutions in the tanks where they belong!
- Return to the tanks as much escaping liquid as possible!
- Use the least amount of rinse water required for good rinsing!

Dragout Reduction Techniques

For Any Parts Washing, Preparation or Plating Operations (Percent Shops Using Technique)

- Still rinse (61%)
- Increase drip time (60%)
- Increase extraction time (38%)
- Decrease viscosity (32%)
- Improve rack orientation (51%)
- Lower bath conc. (34%)
- Captive spray rinsing (19%)
- Drain boards (56%)

Dragout Management

- Recycle Method (Return to process)
  - Atmospheric Evaporation
  - Ion Exchange
  - Electrolytic
- Recycle Method (Non-Return methods)
  - Electrolytic Recovery
  - Solution/Sludge Recovery with Off-Site Management
  - Waste Exchanges

The Common Rinsing Fallacy

The only way to improve washing & rinsing is to use higher flow rates.

Rinsing = Water

- **Suitable water is costly!**
- **Water can cause difficulties!**
- **Used water represents a disposal problem!**

Establishing Cleanliness Baselines

- Defining Cleanliness Needs
- Rinse Water Bath Conductivity
- Water Break-Free Test (organic soils)
- White Towel Test (inorganic soils)
- Tape Pull Test (inorganic soils)
- UV Detection
- Photo Acoustical Technology (PAT)

Water Conservation Through Improved Rinsing Efficiency

(Percent Shops Using Technique)

- Counter current rinsing (68%)
- Reactive rinsing & water reuse (23%)
- Turn off valves when not in use (66%)
- Air agitated rinsing (58%)
- Flow restrictors (70%)
- Conductivity controls (16%)

Conductivity Flow Control

Typical Rinsing Criteria

Type of Rinse	mg/L
Following Cleaner/Acid	400-1000
Following Function Plating	100-700
Following Bright Plating	5-40

Efficient Spray Rinsing Techniques

- 1/8 to 1/4 water usage as a dip operation
- Fog rinsing above heated process tanks
- Spray impact: flow, pattern, nozzle, distance, pressure & atomization
- Nozzle problems: flow rate, spray pattern, spray drop size, spray impact & alignment

Extending Bath Life

(Percent Shops Using Technique)

- Filtration
- Removing dropped parts (78%)
- Removing anodes when bath is idle (24%)
- Oil skimming, absorbing
- Chemical analysis (92%)
- Statistical process control
- Chemical treatment

Process Bath Filtration

Types

- Cartridges
- Disk
- Bag
- In-tank
- External
- Reusable
- Disposable
- Carbon / Ion exchange

Benefits

- Removes particles down to 1 micron
- Extends bath life 2-4x
- Improves quality
- Offers quick payback
- Provides agitation

Membrane Applications

- Degreasing oils concentration
- Coolant emulsion concentration
- Latex concentration
- Paint pigment recovery
- Laundry water reuse
- Pharmaceutical purification
- Dye recovery
- Caustic/acid recovery
- Wine clarification
- Brine recovery
- Alkaline cleaner recycling

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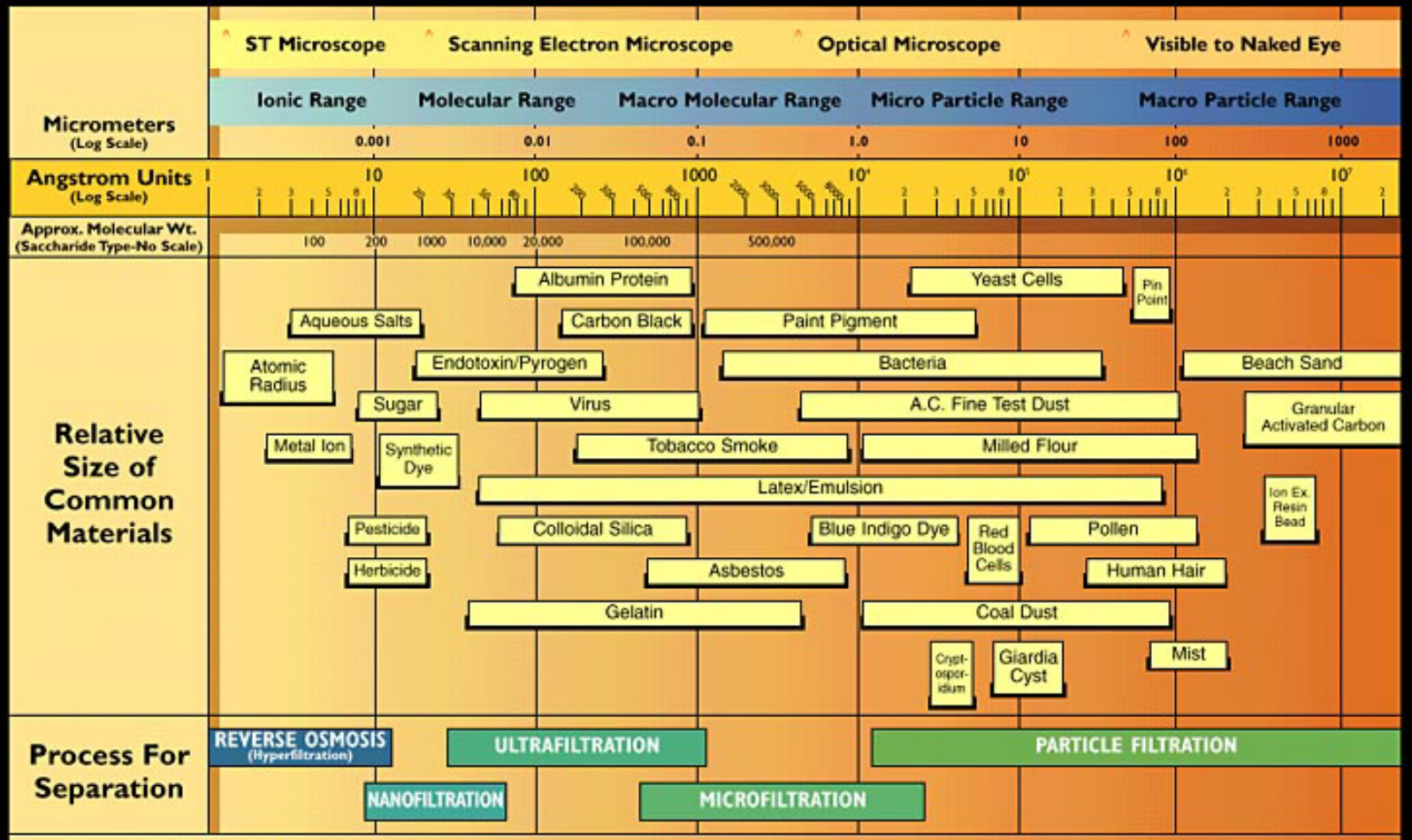
The Filtration Spectrum



Note: 1 Micron (1×10^{-6} Meters) = 4×10^{-5} Inches (0.00004 Inches)
1 Angstrom Unit = 10^{-10} Meters = 10^{-4} Micrometers (Microns)

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Phosphatizing Processes

- Treats Mainly Steel and Iron Substrate
  - To impart Corrosion Resistance and Promote Adhesion of Finishes (i.e. Paint, Laquer, etc.)
- Provides a Coating of Insoluble Metal-Phosphate Crystals to Substrate
- Applies an Iron, Zinc, Manganese, Chromium Phosphate Solution to Substrate
- Iron and Zinc Phosphate – Most Common Types of Phosphating

Possible Modifications to Existing Phosphatizing System

- Reuse DI Water and other Water to Enhance the Quality of Cleaning
- Cascade the Rinses Where Overflow Volumes are the Greatest (i.e. > than 5 gpm)
- Use Overflow from Post Stages to Heated Tanks (Greatest Loss of Water due to Evaporation)
- Add a Prerinse Stage Before Cleaner Stage to Loosen and Remove Soils and Reuse Water from Cleaner Stage to Prerinse Stage

P2 in the Phosphatizng Process

- Reduce Chemical Use
  - Analyze and Control the Solution's Temperature, Chemical Concentration, and pH level in each Step
  - Recirculate Phosphate Solution
- Use Ultrafiltration to Maintain Baths or a Continuous Recirculation System Through A Clarifier to Reduce Amount of Sludge Generated

P2 in the Phosphatizing Process

- Reduce Water Use
  - Counter Flow Water to Rinse Tanks
- Analyze Incoming City Water-Possibly High Amounts of Total Dissolved Solids (TDS)
  - Determine Control Set Points
  - Treat and Condition Water-De-Ionized (DI) or Reverse Osmosis (RO) Water

Other P2 Opportunities

- Reduce Carryover (Dragout)
  - Design System for Minimal Dragout (Includes Adequate Drip Time, Angle Parts, and Drain Zones Between Stages)
- Control Water Flow
  - Install Flow Meters
  - Install Flow Restrictors
  - Do Not Use Ball Valves (Only On and Off Option)

Other P2 Opportunities

- Maintain Automated Systems (i.e. Speed, Chemical Additions, etc.)-High Frequency of Bath Solution Turnover Is A Good Indicator of It Not Being Maintained!
- Clean and Properly Position Spray Nozzles
- Train Employees
- Conduct Daily Inspection of System

Plating/Painting Facility Reuse of Wastewater

- Installed Wastewater Reuse System in July 2001
- Installed Piping to Recycle Treated Water back to Non Critcal Rinsing (NCR) Stages of Plating Lines
- Installed Solenoid Valves at NCR Stages

Plating/Painting Facility Reuse of Wastewater

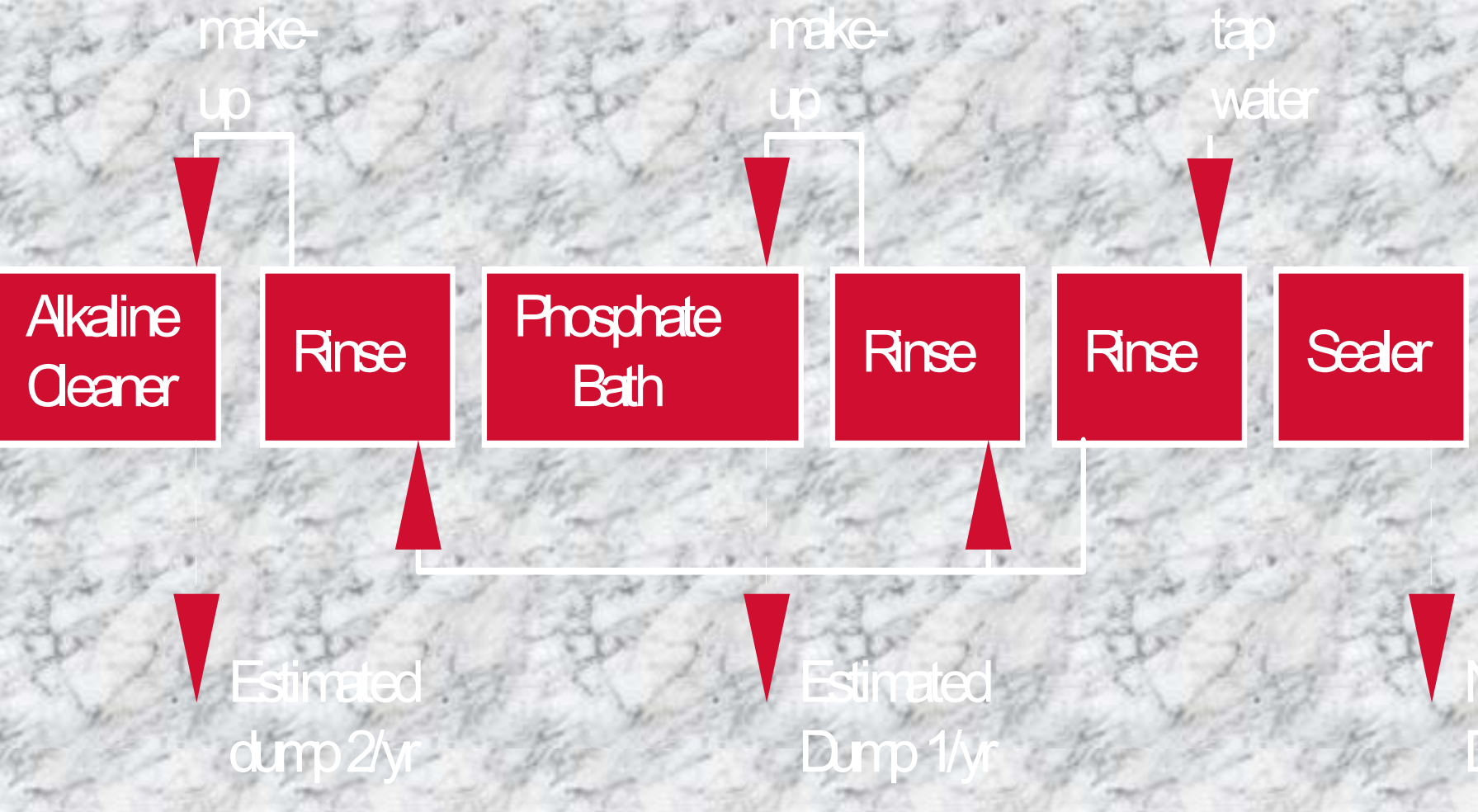
- Use About 35 Million Gallons of Water Per Year for All Facility Operations
- Currently Reusing About 10% Treated Wastewater
- Expect to Increase the Amount of Water Reuse as the System Develops

Closed-Looped Phosphatizing

B & W Metal Fabricators, Inc.

- 6 tank metal surface preparation
- Counterflow rinses with conductivity control
- Evaporation tanks
- 96% reduction in water, 50% reduction in bath chemicals
- Less than two year payback

Closed-Looped Phosphatizing Line



Closed-Looped Aqueous Degreasing

Common System Changes

- 2 to 3 stages counterflow cascade rinses
- Microfiltration recycling (ceramic membranes)
- Higher cleaner temperature (160-175 F)
- Use of DI water for rinse feed
- Quick payback

Other Process Water Conservation Measures

- Reuse of once through, non-contact cooling water for next process bath or for pre-heat
- Reuse of oil/water separator filtrate for mop water or paint booth water curtains
- Water flow timers, flow restrictors, water use inventories, and operator training

Water-Borne Paint Cleanup Management

- Wetting agents to assist paint line flushing / water evaporated - no solvents used
- First line flush-out saved as reducer for next paint batch
- Water & solvent flushes kept separate for reuse & P2/waste minimization

Efficient Washing Techniques

- Low Volume - High Pressure Nozzle
- Air Assisted Nozzle
- Conduct “Dry Cleanup” First
- Proper Equipment, Technique & Training

Boiler Water BMPs

- Chemical metering systems
- Biocide selection
- Improved blowdown techniques (total dissolved solid >= 2000 ppm)
- Temperature optimization
- Fuel & Air mixture controls

Cooling Tower Water Management

- Chemical metering systems
- Alternative bacteria control systems (elimination of chromium)
- Drift reduction
- Efficient water distribution systems

Restroom
Water Conservation

- Install aerators, spring loaded valves, or timers on all faucets
- Reduce toilet water use by installing tank displacement devices or water-saving diaphragms
- Install low-flow toilets (1.6 gallons per flush)
- Repair leaking toilets, faucets, & showers

Landscaping & Outdoor Water Use

- Water in early morning or evening when wind and evaporation are lowest
- Wait 10-14 days before watering after heavy rain
- Raise mower blades to 2 1/2 to 3 1/2 inches in summer so grass retains more moisture
- Consider drip irrigation vs. overhead sprinklers
- Sweep - never hose - sidewalks, docks, parking lots

Surface Preparation And Coating Links

- Pollution Prevention Guide for Surface Coating Removal

http://www.tnrcc.state.tx.us/exec/oppr/p2_info/coatings_removal.html

- Pollution Prevention for Wastewaters TIPS: Pollution Prevention Guide for Surface Coating Operations

http://www.twua.org/p2/Tips/Coatings.html

- Minnesota Technical Assistance Program

http://www.mntap.umn.edu/

- University of Illinois' Waste Management Research Center

http://www.wmrc.uiuc.edu/manuals/coatings/backgr.htm#Coatings

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Next Steps: "Dee-fusion" of Electroplating P2 Technologies

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